

Hazards and Reclamation of Uranium Mine TENORM Wastes

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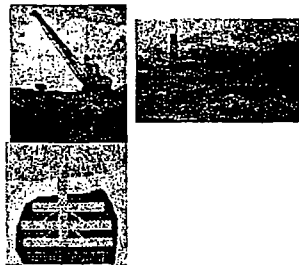
Previous EPA Uranium Reports

- 1983 (ORIA) – Report to Congress on the Potential Health and Environmental Hazards of Uranium Mine Wastes
- 1985 (OSW) – Report to Congress on Wastes from the Extraction and Beneficiation of Metallic Ores, Phosphate Rock, Asbestos, Overburden from Uranium Mining, and Oil Shale
- 1993/1994 (ORIA) – Draft Diffuse NORM Risk Assessment and Waste Characterization. SAB review
- 1995 (OSW)–Extraction and Beneficiation of Ores and Minerals: Uranium



Uranium Mining, Associated TENORM Wastes

- Until 1990s, most uranium mining utilized conventional mining methods—surface and underground extraction
- Since 1990s, until now, most uranium has been produced by in-situ leaching





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Uranium Mining, Associated TENORM Wastes

- TENORM-- Material containing radionuclides that are present naturally in rocks, soils, water, and minerals and whose radioactivity has become concentrated and/or exposed to the accessible environment as a result of human activities
- Uranium mining TENORM includes (generally): Overburden, drill cuttings, protore, barren rock, liquid wastes and pit water, and much more



Uranium Mining, Associated TENORM Wastes

- Operations regulatory agencies:
 - Conventional mines – land management agencies (Federal and State)
 - In situ leach operations – NRC and Agreement States; leasing or claim patenting by land management agencies; UIC well approvals by EPA and delegated states
 - Mills – NRC and Agreement States



Uranium Mining, Associated TENORM Wastes

- Conventional mining cleanup
 - Producing companies
 - Legacy mines – land management agencies using PRPs if possible, SMCRA funds, internal funds; EPA CERCLA funding
- In situ leaching cleanup
 - Current mines – producing companies, oversight by NRC and Agreement States
 - 11e. (2) wastes versus TENORM



Current Studies and Reports

- Technologically Enhanced Naturally Occurring Radioactive Materials From Uranium Mining -
– Volume 1: Mining and Reclamation Background
- Volume 2: Investigation of Potential Cancer Risks from Abandoned Uranium Mines



Current Studies and Reports

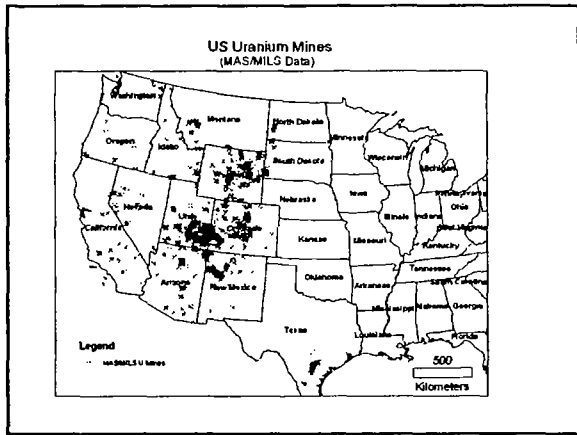
- Regional GIS cooperation project, originally only for Colorado Plateau
- Cooperators included State and Federal agencies, Tribes, EPA Regions 6, 8, 9 and ORIA. Covers 14 western states

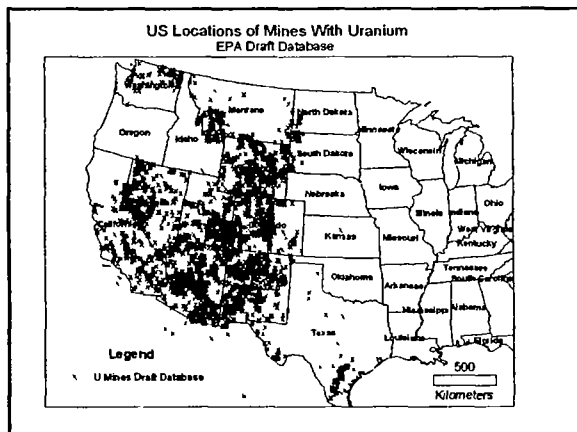


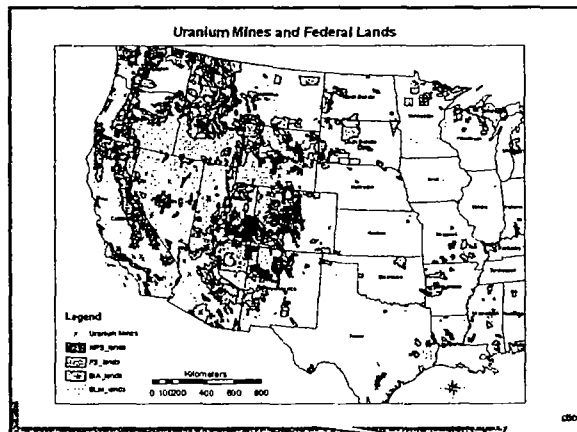
Current Studies and Reports

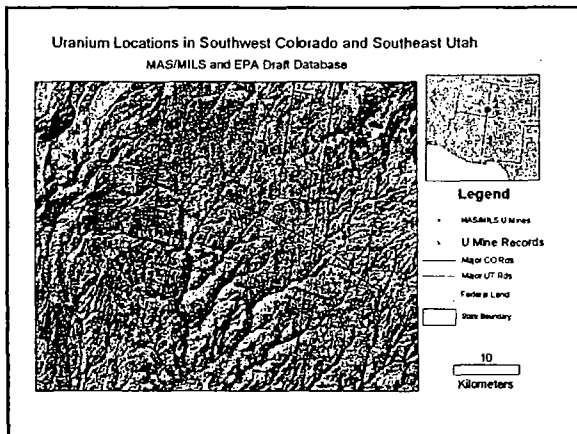
- GIS has ~60 data layers
- Uranium data sets comprised of Interior's MAS/MILS, DOE/EIA, other Federal and State agency mine spatial location data
- MAS/MILS: 8,162 U records, 4,072 past producers (mines)
- 15,000+ mine records in combined ORIA database
- QA/QC review identified duplicates

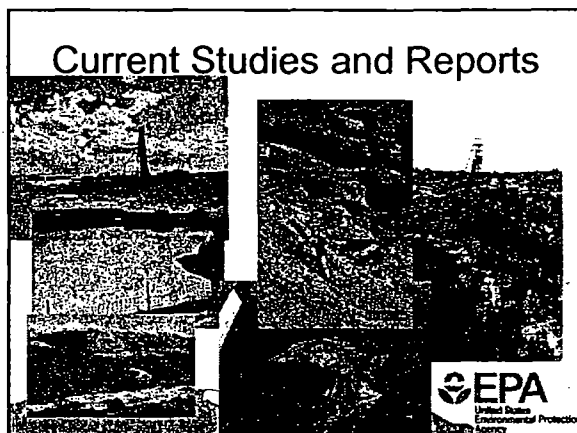












Current Studies and Reports

- Major open-pit mines had 10's to 100's of acres disturbed for storage of overburden
- Surface areas disturbed by major underground mines generally <50 acres
- Acreage of in situ leach operations regulated by NRC varies from about 200 to over 6,000 acres, though only a portion of that is disturbed for well sites, facilities, and ponds

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Current Studies and Reports

Estimated overburden produced by surface and underground mining ~4000 producers (Otton - USGS 1998 for EPA)

MINING METHOD	ESTIMATED OVERBURDEN PRODUCED (MT)		
	LOW ESTIMATE	HIGH ESTIMATE	AVERAGE
Surface Mining	1,000,000,000	8,000,000,000	3,000,000,000
Underground Mining	5,000,000	100,000,000	67,000,000

- These estimates may be low considering the numbers of sites identified by the EPA GIS effort
- Surface mining produced 45 times more overburden than underground mines



Current Studies and Reports

• Overburden radium-226 ranges:

- 58 samples from 17 mines, 69% > 5 pCi/g and 50% > 20 pCi/g (EPA 1985)
- Values > 20 pCi/g unusual, protore 30-600 pCi/g (Otton-USGS 1998)
- White King 53 pCi/g in near surface overburden while Lucky Lass sample had only 2 pCi/g (Weston 1997)



Current Studies and Reports

- Gamma exposure rates for overburden materials range from 20 μ R/hr to 300 μ R/hr
- Protore gamma exposure rate ranges from 80 to 1,250 μ R/hr (200 to 1,000 μ R/hr corresponds to about 0.1 to 0.3% uranium ore)



Current Studies and Reports

- Radon flux rates for overburden:
 - 2–60 pCi/m²s, few hundred pCi/m²s for protore (EPA 1989)
 - about 0.6 to 5.0 pCi/m²s for background soils
- Radon exhalation 212 pCi/L to 540 pCi/L – abandoned Alaska Ross-Adams underground mine opening



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Current Studies and Reports

- Mine reclamation procedures and practices
 - Surface and underground mines
 - In situ leach operations
 - Solid wastes
 - Liquid wastes and aquifer/ground water protection
 - Stewardship issues



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Current Studies and Reports

- DOE 2000 study of costs of remediating 21 uranium mines
 - Reclamation costs ranged from \$0.24/MT of ore produced and \$2,337/hectare of disturbance, to \$33.33/MT of ore and \$269,531/hectare of disturbance
 - Average total estimated reclamation cost was \$13.9 million per mine – Differences based on mine size, accounting methods



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Current Studies and Reports

- DOE 21 mine sites studied:
 - 96.9 million MT ore, 114,803 MT of uranium
 - Lowest cost of closure, \$/lb uranium yellowcake: \$0.18
 - Highest cost of closure, \$/lb uranium yellowcake: \$23.74
 - Cost data developed for 2002 IAEA/NEA report

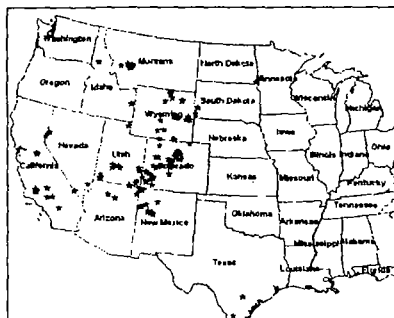


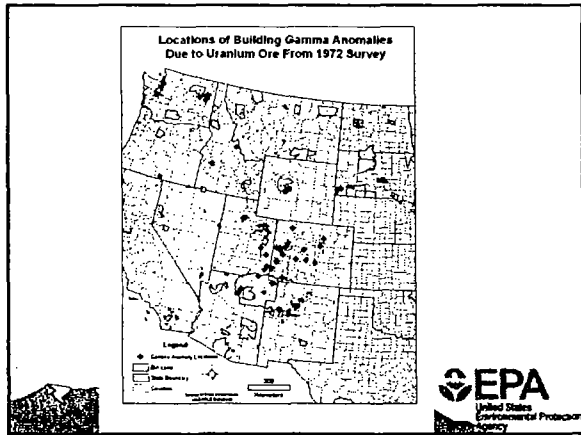
Current Studies and Reports

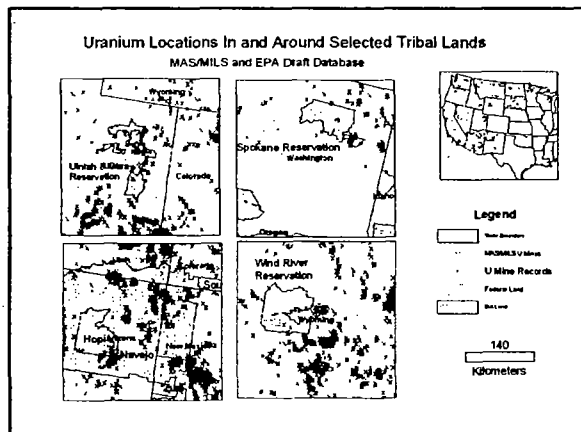
- Most likely risks of exposure to uranium mining TENORM to:
 - Tribal populations
 - Individuals building with, on, or adjacent to uranium mine waste
 - Federal land users –
 - Recreation
 - Workers

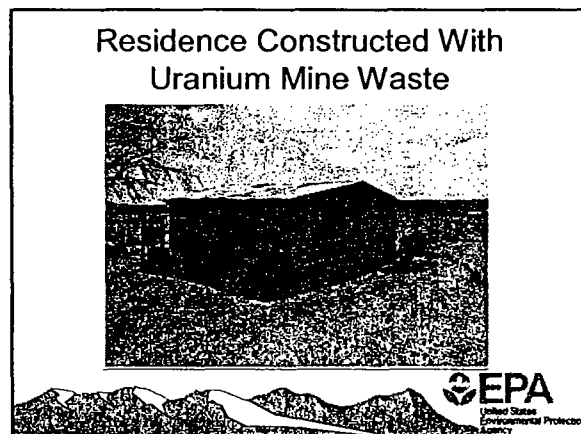


Places Within 5 Miles of a MAS/MILS Mine Record







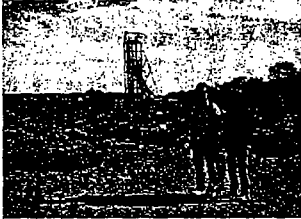







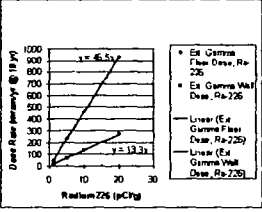

Adjacent Resident to a Uranium Mine

Federal Land Users: Recreation, Workers

Risk Modeling Example

Future Plans

- Issue reports on uranium mining TENORM wastes
- ORIA will be looking for dialogue with affected stakeholders. Will begin with State, Federal, and Tribal agencies
 - Will be designed to determine interest and need for ORIA technical, education, other assistance
 - Intended to find ways to partner to reduce radiation exposures



Summary

- ORIA is updating available information on uranium mining TENORM
- Modern studies and analyses provide better understanding of radiation protection issues, stakeholders impacted by legacy mines
- New reports and stakeholder meetings will be used to increase dialogue and potential partnerships for reducing radiation exposures to uranium mining TENORM wastes